EFFECTS OF COMPOSITION ON PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

SAMPLE	PVA/PVP (PARTS)	DENSITY (g/cc)	TENSILE STRENGTH (MPa)[5]	ELONGATION (AT BREAK, %)[5]	YOUNG'S MODULUS (MPa)[5]
1	0/0	0.53	6.47 ± 0.56	7.67 ± 1.61	164.90 ± 49.60
2	2/0	0.61	4.70 ± 0.37	23.39 ± 5.09	125.30 ± 33.33
3	3/0	0.47	5.72 ± 0.55	28.13 ± 12.05	153.00 ± 33.43
4	2/2	0.47	7.61 ± 0.64	8.48 ± 0.82	178.70 ± 25.40
5	10/3	0.52	6.95 ± 0.75	15.22 ± 3.46	161.00 ± 24.20

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 25 PARTS GLYCEROL, AND 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON 100 PARTS DRY WEIGHT SOY PROTEIN)
[5]MEAN ± STANDARD DEVIATION.

Fig. 1

EFFECTS OF PVA CONCENTRATION ON PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

SAMPLE	PVA/PVP (PARTS)	DENSITY (g/cc)	TENSILE STRENGTH (MPa)[5]	ELONGATION (AT BREAK, %)[5]	YOUNG'S MODULUS (MPa)[5]
1	0	0.45	4.96 ± 0.88	3.69 ± 0.75	205.7 ± 38.2
2	10/2	0.54	6.40 ± 0.68	4.2 ± 0.56	243.6 ± 38.7
3	20/2	0.56	7.54 ± 0.82	9.17 ± 2.86	257.7 ± 51.10
4	30/2	0.52	7.65 ± 0.68	6.72 ± 1.55	266.4 ± 27.4
5	40/2	0.53	8.04 ± 0.48	11.61 ± 3.08	281.1 ± 27.9

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 20 PARTS GLYCEROL, 0.5 PARTS POTASSIUM SORBATE (PRESERVATIVE), AND 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON 100 PARTS DRY WEIGHT SOY PROTEIN)
[5]MEAN ± STANDARD DEVIATION.

Fig. 2

EFFECTS OF OCTENYLDECENE SUCCINIC ANHYDRIDE ON PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

SAMPLE	PVA/PVP	ODSA[5]	DENSITY (g/cc)	TENSILE STRENGTH (MPa)[6]	ELONGATION (AT BREAK, %)[6]	YOUNG'S MODULUS (MPa)[6]
1	0	0	0.50	6.30 ± 4.02	4.02 ± 0.61	193.7 ± 25.4
2	10/2	2	0.51	6.21 ± 0.61	5.28 ± 0.35	141.2 ± 35.5
3	20/2	2	0.55	6.52 ± 0.51	12.93 ± 3.09	190.5 ± 52.40
4	30/2	2	0.52	6.61 ± 0.40	14.15 ± 3.10	151.0 ± 20.4
5	40/2	2	0.45	6.43 ± 0.53	11.39 ± 2.68	170.10 ± 34.57

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 20 PARTS GLYCEROL, 0.5 PARTS POTASSIUM SORBATE (PRESERVATIVE), AND 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON 100 PARTS DRY WEIGHT SOY PROTEIN)
[5]ODSA: OCTENYLDECENE SUCCINIC ANHYDRIDE
[6]MEAN ± STANDARD DEVIATION.

Fig. 3

EFFECTS OF GLYCEROL CONCENTRATION ON PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

GLYCEROL (PARTS)	PVA/PVP	DENSITY (g/cc)	TENSILE STRENGTH (MPa)	ELONGATION (AT BREAK, %)	YOUNG'S MODULUS (MPa)
BLANK	0/0	0.46	5.86 ± 0.38	11.54 ± 2.41	158.8 ± 39.6
20	10/3	0.44	6.57 ± 0.55	16.33 ± 0.60	162.7 ± 33.4
25	10/3	0.47	4.89 ± 0.33	37.75 ± 5.08	125.2 ± 26.6
30	10/3	0.47	3.96 ± 0.24	65.52 ± 2.42	90.62 ± 15.12

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON ON 100 PARTS DRY WEIGHT SOY PROTEIN). BLANKS CONTIAN 20 PARTS GLYCEROL.
[5]MEAN ± STANDARD DEVIATION.

Fig. 4

EFFECTS OF GELATIN ON THE PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

SAMPLE	PVA/PVP (PARTS)	GELATIN (PARTS)	DENSITY (g/cc)	TENSILE STRENGTH (MPa)	ELONGATION (AT BREAK, %)	YOUNG'S MODULUS (MPa)
1	0	0	0.46	5.86 ± 0.38	11.54 ± 2.41	158.8 ± 39.6
2	10/3	0	0.44	6.57 ± 0.55	16.33 ± 0.60	162.7 ± 33.4
3	10/3	6	0.43	7.11 ± 0.48	14.42 ± 1.48	170.8 ± 37.8
4	10/3	10	0.52	7.47 ± 0.30	18.81 ± 6.06	162.5 ± 16.2

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 20 PARTS GLYCEROL, 0.5 PARTS POTASSIUM SORBATE (PRESERVATIVE), AND 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON 100 PARTS DRY WEIGHT SOY PROTEIN)
[5]MEAN ± STANDARD DEVIATION.

Fig. 5

EFFECTS OF PROCESSING AIDES ON PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

SAMPLE (0.5 PARTS)	PVA/PVP	DENSITY (g/cc)	TENSILE STRENGTH (MPa)	ELONGATION (AT BREAK, %)	YOUNG'S MODULUS (MPa)
BLANK	0	0.44	2.96 ± 0.20	42.20 ± 5.84	56.37 ± 8.65
NaCl[6]	2/1	0.49	3.63 ± 0.32	52.48 ± 12.76	91.84 ± 17.62
Na_2SO_3[6]	2/1	0.51	3.50 ± 0.36	60.88 ± 6.25	76.18 ± 11.37
CaSt[6]	2/1	0.63	3.88 ± 0.28	56.80 ± 9.58	86.77 ± 35.12
ZnSt[6]	2/1	0.59	3.35 ± 0.07	48.59 ± 7.81	68.11 ± 9.32
SDS[6]	2/1	0.53	3.57 ± 0.34	62.00 ± 7.88	104.60 ± 26.54
UNIFLEX[6]	2/1	0.60	3.06 ± 0.16	50.22 ± 2.99	73.49 ± 23.88
Int-38H[6]	2/1	0.56	3.24 ± 0.40	50.42 ± 8.22	85.43 ± 25.50
Int66HS[6]	2/1	0.61	3.95 ± 0.27	57.64 ± 6.79	88.11 ± 15.80

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 20 PARTS GLYCEROL, 0.5 PARTS POTASSIUM SORBATE (PRESERVATIVE), AND 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON 100 PARTS DRY WEIGHT SOY PROTEIN)
[5]MEAN ± STANDARD DEVIATION.
[6]NaCl= SODIUM CHLORIDE, Na_2SO_3= SODIUM SULFITE, CaSt= CALCIUM STEARATE, ZnSt= ZINC STEARATE SDS= SODIUM DODECYL SULFATE, UNIFLEX= COMMERCIAL LUBRICANT FROM UNION CAMP COMPANY, INT-38H= INTERNAL LUBRICANT FROM AXEL COMPANY, INT-66HS= INTERNAL LUBRICANT FROM AXEL COMPANY

Fig. 6

EFFECTS OF FLAVORING AGENTS ON PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

SAMPLE	FLAVORING AGENT	PVA/PVP	DENSITY (g/cc)	TENSILE STRENGTH (MPa)	ELONGATION (AT BREAK, %)	YOUNG'S MODULUS (MPa)
1	0	3/2	0.42	5.45 ± 0.80	10.54 ± 2.47	172.40 ± 31.6
2	0	3/2	0.47	5.72 ± 0.55	28.13 ± 12.05	153.00 ± 33.43
3	LEMON	3/2	0.39	4.92 ± 0.83	10.97 ± 1.39	136.10 ± 19.63
4	ALMOND	3/2	0.38	5.18 ± 0.95	13.31 ± 1.90	137.20 ± 24.81

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 20 PARTS GLYCEROL, 0.5 PARTS POTASSIUM SORBATE (PRESERVATIVE), AND 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON 100 PARTS DRY WEIGHT SOY PROTEIN)
[5]MEAN ± STANDARD DEVIATION.
LEMON AND ALMOND FLAVORING AGENTS= 1 PART EACH

Fig. 7

EFFECTS OF COLORANTS ON PHYSICAL PROPERTIES OF SPI[1]/PVA[2]/PVP[3] FOAM SHEETS[4]

SAMPLE	COLORANT	PVA/PVP	DENSITY (g/cc)	TENSILE STRENGTH (MPa)	ELONGATION (AT BREAK, %)[5]	YOUNG'S MODULUS (MPa)
1	0	0/0	0.42	5.45 ± 0.80	10.54 ± 2.47	172.40 ± 31.6
2	10/3	3/2	0.47	5.72 ± 0.55	28.13 ± 12.05	153.00 ± 33.43
3	PHTHALOCYANINE[6]	3/2	0.59	4.30 ± 0.45	20.84 ± 5.0	111.30 ± 25.50
4	PHTHALOCYANINE GREEN[7]	3/2	0.59	4.47 ± 0.33	23.06 ± 12.37	128.80 ± 20.54

[1]SPI: SOY PROTEIN ISOLATE
[2]PVA: POLY(VINYL ALCOHOL)
[3]PVP: POLY(VINYL PYRROLIDONE)
[4]FORMULATION: 100 PARTS SPI, 80 PARTS WATER, 20 PARTS GLYCEROL, 0.5 PARTS POTASSIUM SORBATE (PRESERVATIVE), AND 1 PART SODIUM TRIPOLYPHOSPHATE, (ALL BASED ON 100 PARTS DRY WEIGHT SOY PROTEIN)
[5]MEAN ± STANDARD DEVIATION.
[6]PHTHALOCYANINE (BLUE/GREEN) = 0.05 PARTS
[7]PHTHALOCYANINE GREEN (GREEN) = 0.05 PARTS

Fig. 8

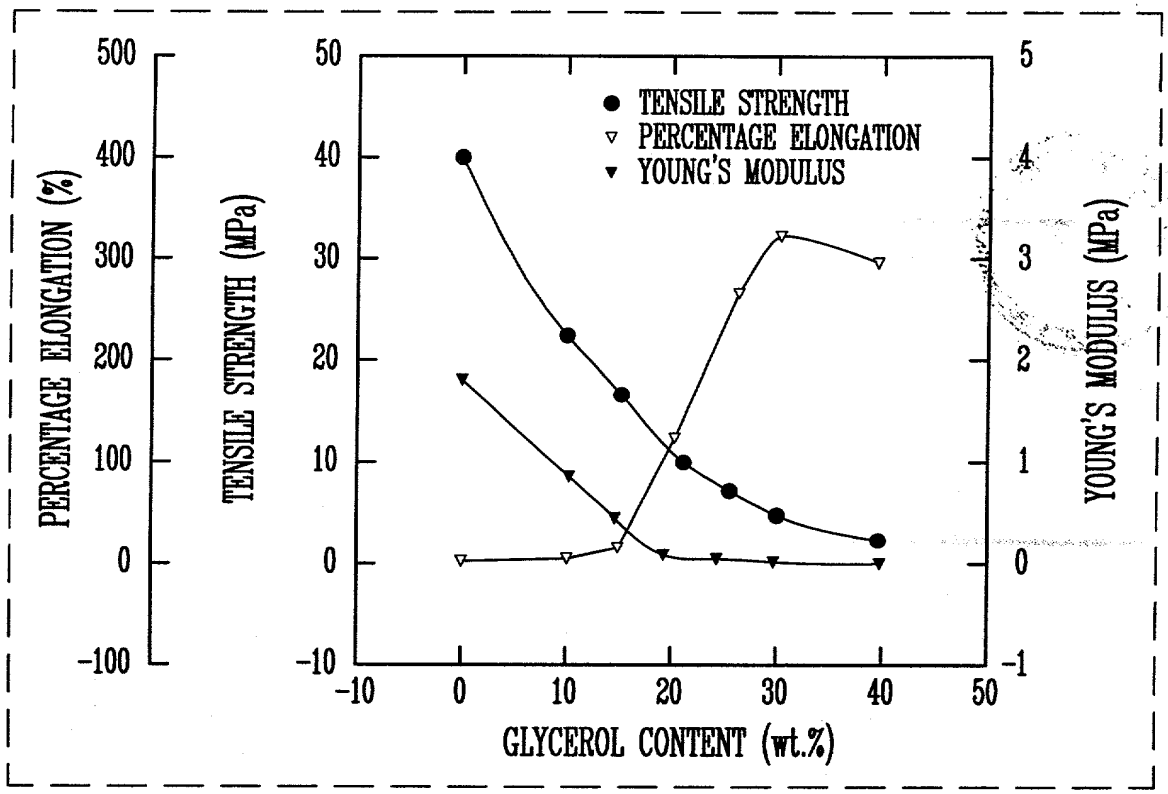

PERCENTAGE ELONGATION (%)
TENSILE STRENGTH (MPa)
YOUNG'S MODULUS (MPa)
GLYCEROL CONTENT (wt.%)
TENSILE STRENGTH
PERCENTAGE ELONGATION
YOUNG'S MODULUS
500
400
300
200
100
0
-100
50
40
30
20
10
0
-10
5
4
3
2
1
0
-1
-10
0
10
20
30
40
50

Fig. 9

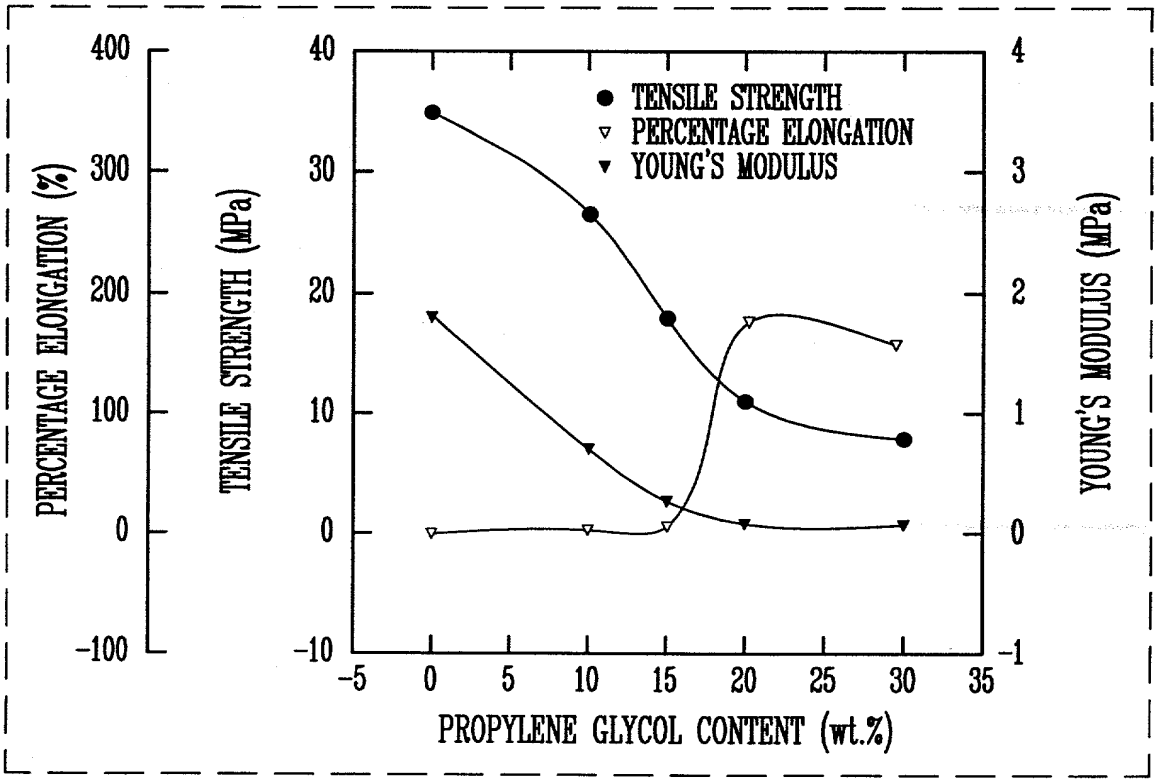

PERCENTAGE ELONGATION (%)
TENSILE STRENGTH (MPa)
YOUNG'S MODULUS (MPa)
PROPYLENE GLYCOL CONTENT (wt.%)
TENSILE STRENGTH
PERCENTAGE ELONGATION
YOUNG'S MODULUS
400
300
200
100
0
-100
40
30
20
10
0
-10
4
3
2
1
0
-1
-5
0
5
10
15
20
25
30
35

Fig. 10

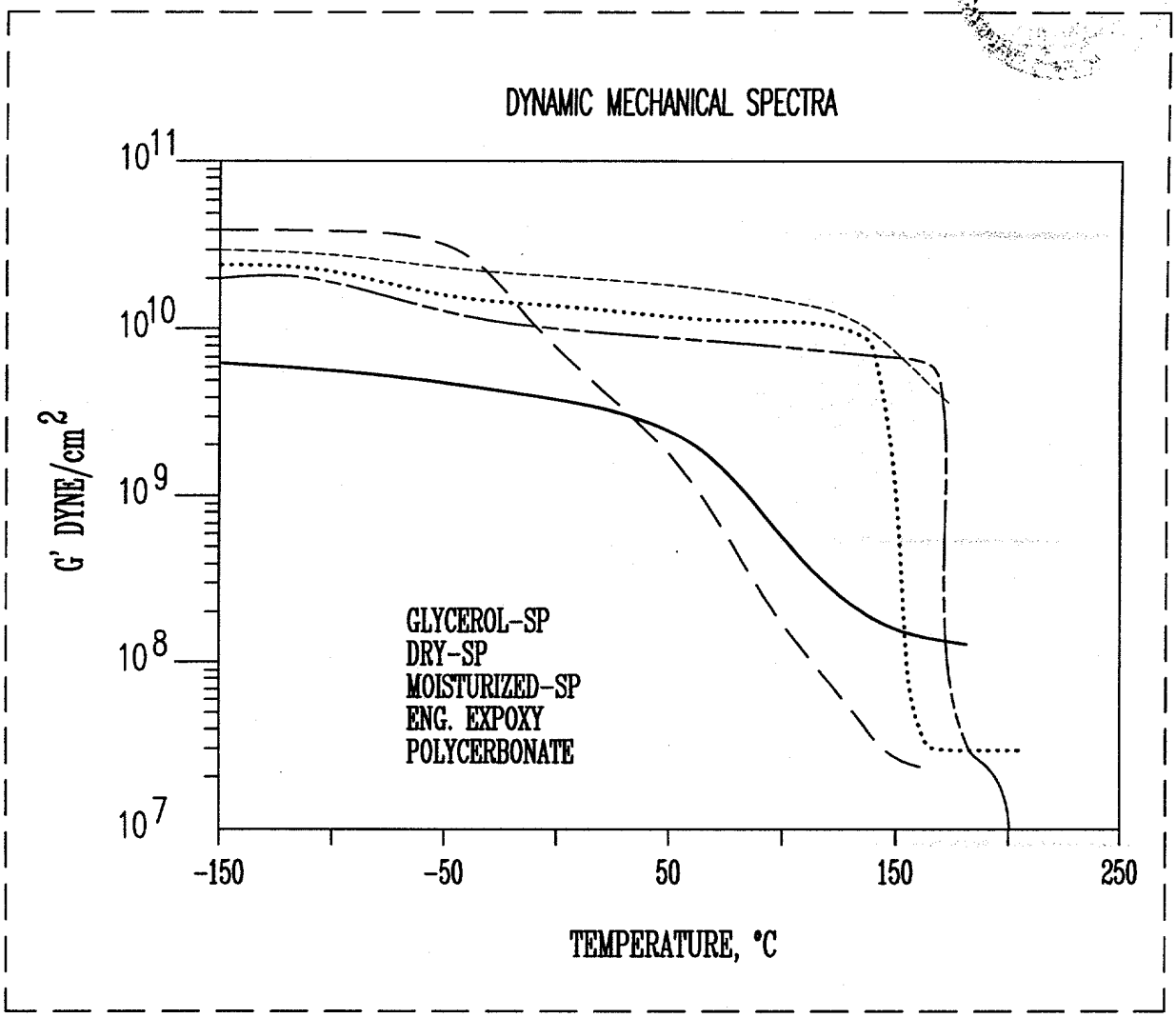
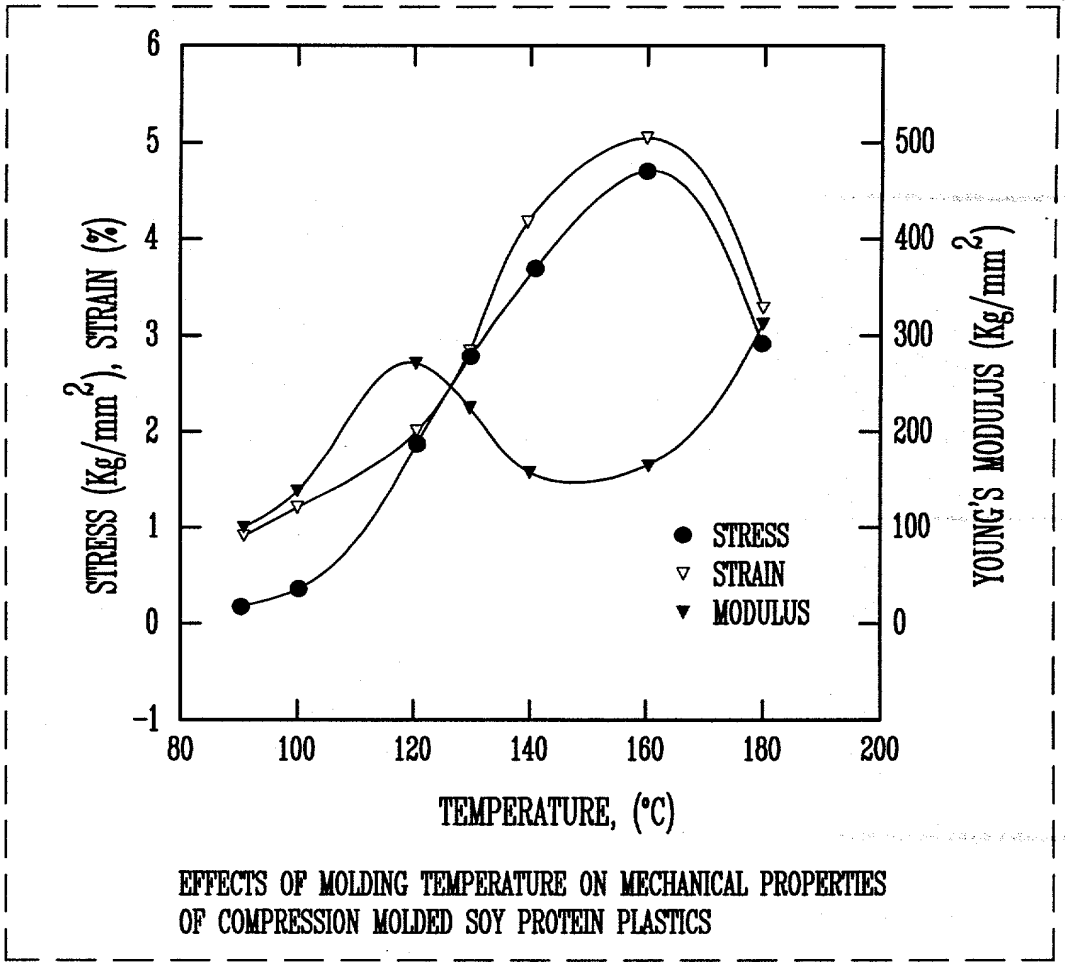

DYNAMIC MECHANICAL SPECTRA
10^{11}
10^{10}
10^{9}
10^{8}
10^{7}
G' DYNE/cm^2
GLYCEROL-SP
DRY-SP
MOISTURIZED-SP
ENG. EXPOXY
POLYCERBONATE
-150
-50
50
150
250
TEMPERATURE, °C

Fig. 11



EFFECTS OF MOLDING TEMPERATURE ON MECHANICAL PROPERTIES OF COMPRESSION MOLDED SOY PROTEIN PLASTICS

Fig. 12

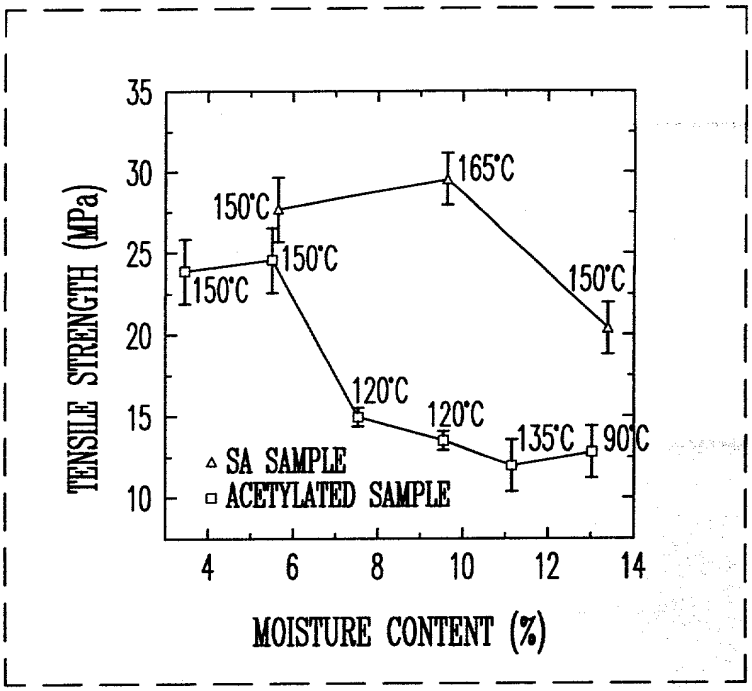


Fig. 13A

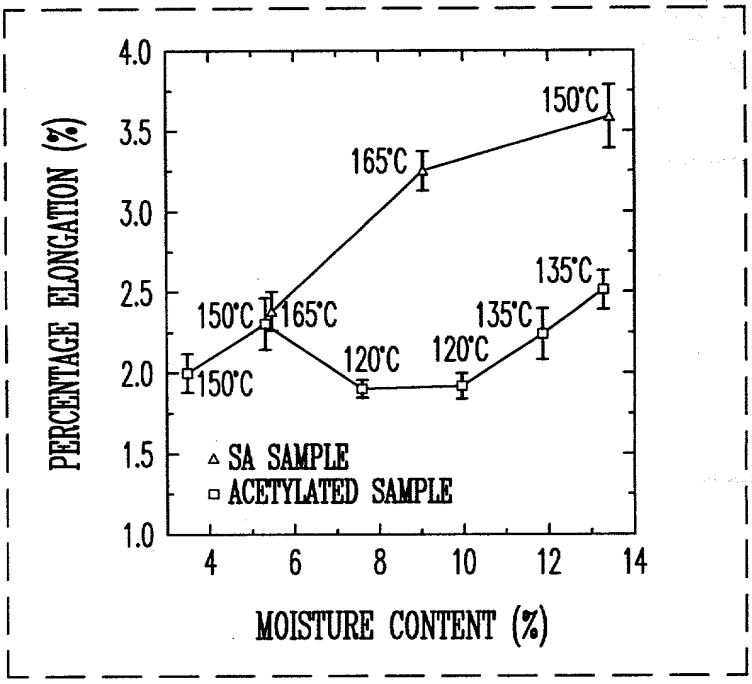


Fig. 13B

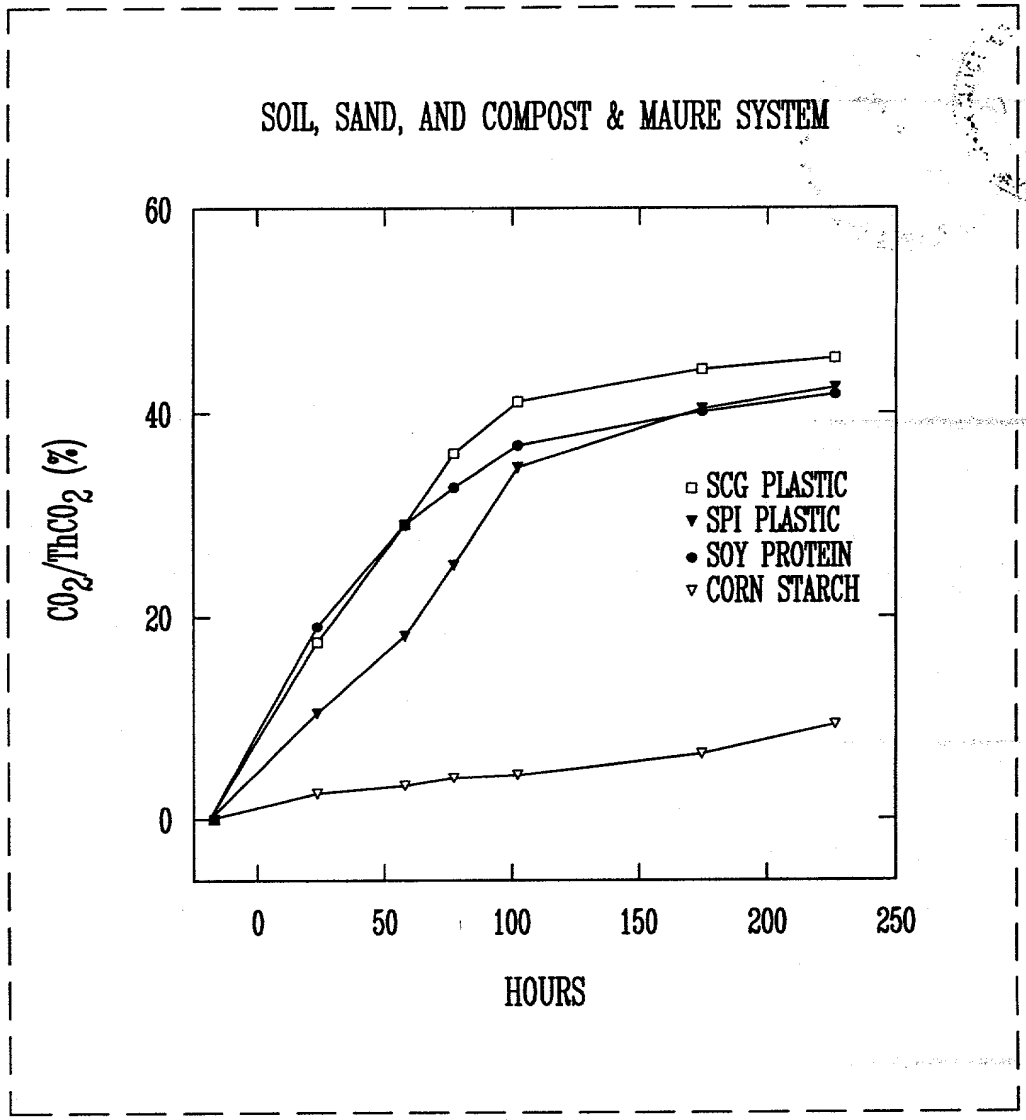

SOIL, SAND, AND COMPOST & MAURE SYSTEM
60
40
20
0
$CO_2/ThCO_2$ (%)
0
50
100
150
200
250
HOURS
SCG PLASTIC
SPI PLASTIC
SOY PROTEIN
CORN STARCH

Fig. 14